

Decortication in Chronic Pleural Empyema and Its Effect on Lung Function in Pediatric patients

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ABSTRACT

Background: Chronic pleural empyema, a condition marked by ongoing pleural infection and the development of a fibrous sheath around the lungs, severely impacts lung function and overall well-being in pediatric patients. Decortication is a surgical procedure aimed at removing this fibrous layer to restore normal lung mechanics. This study investigates the impact of decortication surgery on lung function in children with chronic pleural empyema and evaluates how factors such as malnutrition, obesity, and cardiovascular conditions influence surgical outcomes.

Methods: This prospective cohort study included 80 children aged 5 to 15 years diagnosed with chronic pleural empyema who underwent decortication. Clinical and demographic data, including age, sex, nutritional status, and comorbidities, were collected. Lung function was evaluated through spirometry before and after surgery, focusing on parameters such as FEV1 and FVC. Postoperative complications, including bleeding, infections, and air leaks, were recorded along with hospital stay duration. Paired t-tests assessed changes in lung function, while subgroup analyses explored the effects of malnutrition and other comorbidities on recovery.

Results: The participants had an average age of 10.2 ± 2.8 years, with males accounting for 60% of the cohort. Post-surgical lung function showed significant improvement, with FEV1 rising from 1.2 ± 0.3 L to 1.7 ± 0.4 L ($p < 0.001$) and FVC increasing from 1.6 ± 0.4 L to 2.3 ± 0.5 L ($p < 0.001$). Common complications included bleeding (10%), infections (12%), and prolonged air leaks (15%). Malnutrition was associated with slower recovery and a higher rate of complications. The average hospital stay was 10 ± 3 days.

Conclusion: Decortication is highly effective in improving lung function in children with chronic pleural empyema. Even in patients with malnutrition and comorbidities, this intervention demonstrates significant benefits. These findings underscore the value of timely surgery and individualized perioperative care in improving outcomes for this vulnerable group.

Keywords: Chronic pleural empyema, decortication, pediatric surgery, lung function improvement, malnutrition, postoperative care.

1. INTRODUCTION

Chronic pleural empyema is a condition marked by persistent infection in the pleural space, leading to lung restriction due to fibrous encasement. This condition significantly affects the pediatric population, causing impaired lung function and increased morbidity. If left untreated, chronic pleural empyema can lead to severe complications, including persistent

respiratory distress and poor overall health. Surgical intervention through decortication has proven to be a reliable approach to restoring lung function by removing the fibrous peel surrounding the lung. However, the pediatric population presents



unique challenges, particularly due to the presence of factors such as malnutrition, cardiovascular comorbidities, and obesity, which may influence surgical outcomes and recovery rates. Addressing these variables is crucial for tailoring effective treatment strategies for children with this condition [1, 2].

Current study highlights the importance of decortication surgery in managing empyema; however, studies focusing on pediatric outcomes remain limited. This gap in knowledge is particularly evident in understanding how pre-existing conditions such as malnutrition and obesity affect lung recovery post-surgery. In addition, there is limited data on the prevalence and management of postoperative complications such as bleeding, infection, and air leaks, which are critical for planning comprehensive care. This study aims to evaluate the effectiveness of decortication surgery in improving lung function among children aged 5–15 years and to assess the influence of nutritional status and comorbid conditions on surgical outcomes. Furthermore, it seeks to identify common complications and their management to ensure a holistic approach to treatment [3, 4].

This study contributes to the broader understanding of chronic pleural empyema management in children by providing data on lung function recovery and complication rates after decortication surgery. The findings will guide clinicians in adopting tailored strategies to address comorbidities, enhance postoperative care, and minimize complications. Additionally, this research lays the groundwork for future studies to explore long-term outcomes and develop standardized protocols for managing pediatric empyema effectively. Such advancements are vital for improving survival rates and the quality of life in this vulnerable patient population [1, 2].

2. METHODOLOGY

Study Design and Setting

This study was designed as a prospective observational cohort investigation to evaluate the effect of decortication surgery on respiratory function in pediatric patients diagnosed with chronic pleural empyema. A total of 80 pediatric patients, aged between 5 and 15 years, diagnosed with chronic pleural empyema and scheduled to undergo decortication surgery, were included in the study. These patients were recruited from a department of Pediatric Surgery in IGIMS Patna.

Ethical Considerations

This research adhered to the ethical guidelines outlined in the Declaration of Helsinki for medical research. The study was approved by the Institutional Review Board (IRB) or Ethics Committee of the participating hospital. Written informed consent was obtained from the parents or guardians of all pediatric patients involved in the study, ensuring that patient confidentiality and data protection were maintained throughout the study period.

Selection Criteria

Inclusion criteria consisted of pediatric patients diagnosed with chronic pleural empyema, defined by persistent pleural space infection with pus accumulation, and scheduled to undergo decortication surgery. Exclusion criteria included patients with acute pleural empyema, active pulmonary infections (such as pneumonia or lung abscess), and pre-existing conditions like chronic obstructive pulmonary disease (COPD), interstitial lung disease, or cystic fibrosis. Furthermore, patients with contraindications to surgery, such as severe cardiopulmonary instability or uncontrolled comorbidities, were excluded from the study.

Data Sources and Variables

A detailed and systematic data collection process was employed to gather baseline characteristics, preoperative clinical data, surgical details, and postoperative outcomes. The following variables were collected:

Baseline Demographic and Clinical Data:

A comprehensive assessment was conducted at the start of the study, documenting participants' age, sex, and the presence of comorbidities, including cardiovascular disorders. The duration of symptoms and any prior treatments for chronic pleural empyema were also recorded.

Preoperative Lung Function Tests:

Prior to decortication surgery, all participants underwent a battery of lung function tests, which were performed by trained respiratory therapists or pulmonary function technologists according to standardized protocols. Spirometry was used to assess Forced Expiratory Volume in 1 second (FEV1) and Forced Vital Capacity (FVC), which provide insights into airway obstruction and lung capacity. Lung volume measurements (Total Lung Capacity, TLC) and Diffusing Capacity of the Lung for Carbon Monoxide (DLCO) were also measured to assess overall lung function and gas exchange efficiency.

Decortication Surgery:

Decortication surgery was performed by experienced pediatric surgeons specializing in pleural diseases, using standardized surgical techniques to ensure consistency across cases. The procedure aimed to remove the fibrous peel encasing the lung,

thereby improving lung expansion, ventilation, and symptom relief in patients with chronic pleural empyema.

Postoperative Lung Function Tests:

After surgery, participants underwent repeat lung function tests at 3, 6, and 12-month intervals to assess postoperative lung function. These tests included spirometry, TLC, and DLCO to track improvements or changes in respiratory function following the surgical intervention.

Additional Clinical Data:

Along with lung function assessments, clinical data on postoperative complications such as pneumonia, pleural effusion, surgical site infections, and other adverse events were recorded. The length of hospital stay and the requirement for additional interventions were also documented to assess the safety and efficacy of decortication surgery.

Outcome Measures

The primary outcome measure was the change in lung function parameters (FEV1, FVC, TLC, and DLCO) before and after decortication surgery. Secondary outcomes included the occurrence of postoperative complications and the length of hospital stay.

Statistical Analysis Tools

Data were analyzed using SPSS version 20. Descriptive statistics summarized baseline data. Paired t-tests compared preoperative and postoperative lung function, and ANOVA analyzed subgroup differences. Statistical significance was set at $p < 0.05$.

3. RESULT

The study included 80 pediatric patients with a mean age of 10.2 ± 2.8 years, with 60% of them being male. Table 1 summarizes the baseline demographic and clinical characteristics of the participants. Most patients had chronic pleural empyema for at least 3 months before surgery, and 45% of the participants had comorbidities such as cardiovascular conditions and malnutrition, which may influence the surgical outcomes and recovery.

Table 1: Baseline Demographic and Clinical Characteristics

Variable	Value (n = 80)
Age (years)	10.2 ± 2.8
Gender (Male %)	60%
Duration of Empyema (months)	≥ 3
Comorbidities	45%
Cardiovascular Conditions	15%
Malnutrition	30%

Lung Function Improvement

The primary outcomes of the study, including Forced Expiratory Volume in 1 second (FEV1) and Forced Vital Capacity (FVC), showed statistically significant improvements post-surgery. The FEV1 increased from 1.2 ± 0.3 L preoperatively to 1.7 ± 0.4 L postoperatively ($p < 0.001$). Similarly, FVC improved from 1.6 ± 0.4 L to 2.3 ± 0.5 L ($p < 0.001$), demonstrating the effectiveness of decortication surgery in restoring normal pulmonary mechanics (table 2).

Table 2: Lung Function Parameters Before and After Surgery

Parameter	Preoperative (Mean $\pm$ SD)	Postoperative (Mean $\pm$ SD)	p-value
FEV1 (L)	1.2 ± 0.3	1.7 ± 0.4	< 0.001
FVC (L)	1.6 ± 0.4	2.3 ± 0.5	< 0.001

Age Group Analysis

Lung function improvements were analyzed by dividing patients into two age groups (5-10 years and 11-15 years). Significant improvements in both FEV1 and FVC were observed in all age groups.

Table 3: Lung Function by Age Group

Age Group (Years)	FEV1 Preoperative (Mean ± SD)	FEV1 Postoperative (Mean ± SD)	p-value	FVC Preoperative (Mean ± SD)	FVC Postoperative (Mean ± SD)	p-value
5-10	1.1 ± 0.2	1.6 ± 0.3	< 0.001	1.5 ± 0.4	2.2 ± 0.5	< 0.001
11-15	1.3 ± 0.3	1.8 ± 0.4	< 0.001	1.8 ± 0.4	2.4 ± 0.5	< 0.001

Comorbidity Subgroup Analysis

Subgroup analysis revealed that while all subgroups showed improvements in FEV1 and FVC, patients with comorbidities such as cardiovascular conditions or malnutrition showed slightly less improvement compared to those without comorbidities.

Table 4: Lung Function by Comorbidity Subgroup

Comorbidity	FEV1 Preoperative (Mean ± SD)	FEV1 Postoperative (Mean ± SD)	p-value	FVC Preoperative (Mean ± SD)	FVC Postoperative (Mean ± SD)	p-value
Cardiovascular Disease	1.2 ± 0.3	1.6 ± 0.3	< 0.001	1.6 ± 0.5	2.1 ± 0.4	< 0.001
Malnutrition	1.1 ± 0.2	1.5 ± 0.3	< 0.001	1.4 ± 0.4	2.0 ± 0.5	< 0.001
No Comorbidity	1.2 ± 0.3	1.7 ± 0.4	< 0.001	1.6 ± 0.4	2.3 ± 0.5	< 0.001

Postoperative Complications and Length of Hospital Stay

Postoperative complications occurred in a small percentage of patients. Specifically, 10% experienced bleeding, 12% had infections, and 15% suffered prolonged air leaks. The average hospital stay was 10 ± 3 days. In table 6 data suggests that postoperative complications directly contribute to extended hospitalization, increasing the burden on healthcare resources and delaying patient discharge. Managing and preventing these complications can significantly reduce hospital stays and improve patient outcome

Table 5: Postoperative Complications

Complication	Percentage (%)
Bleeding	10%
Infection	12%
Prolonged Air Leaks	15%

Table 6: Length of Hospital Stay

Length of Stay (Days)	Mean ± SD
Overall	10 ± 3
With Complications	12 ± 4
Without Complications	8 ± 2

4. DISCUSSION

This study evaluated the effectiveness of decortication surgery in improving lung function in pediatric patients with chronic pleural empyema. The results demonstrated a significant improvement in both Forced Expiratory Volume in 1 second (FEV1) and Forced Vital Capacity (FVC) following the surgery, confirming the benefits of decortication in restoring lung mechanics. These findings are consistent with previous research that has highlighted the effectiveness of this surgical approach in improving respiratory function in both adult and pediatric populations [1, 2].

The observed improvement in lung function was significant across all age groups, with no significant difference in the degree of improvement between younger children (5-10 years) and older children (11-15 years). This suggests that decortication is an equally effective intervention for patients across this age range, which is important for clinical decision-making in pediatric surgery.

Additionally, the study revealed that comorbidities, particularly cardiovascular diseases and Malnutrition, may slightly reduce the extent of improvement in lung function after decortication surgery. This is a crucial finding for clinicians, as it underscores the importance of addressing comorbid conditions preoperatively and offering more personalized care to ensure optimal outcomes in patients with chronic pleural empyema. Malnutrition also appears to be a factor influencing recovery, with malnourished patients experiencing slower recovery and higher complication rates, as noted in previous studies on pediatric surgical outcomes [3].

While the overall complication rate was low, certain postoperative complications such as bleeding, infections, and prolonged air leaks were noted. These complications are typical in thoracic surgeries and necessitate careful monitoring and management to minimize adverse outcomes and ensure a smooth recovery process. The average length of stay of 10 ± 3 days is relatively short, but it was longer in patients who experienced complications. This finding highlights the need for a proactive approach in managing postoperative care to reduce complications and shorten hospital stays.

The limitations of this study include the absence of a control group and the relatively small sample size. Future studies could benefit from a randomized controlled trial design with larger cohorts to further validate the findings. Additionally, long-term follow-up assessments could help evaluate the sustainability of lung function improvements and identify any long-term sequelae of chronic pleural empyema in pediatric patients.

In conclusion, decortication surgery is an effective intervention for improving lung function in children with chronic pleural empyema. This study highlights the importance of early intervention and the need for tailored perioperative management, particularly for patients with comorbidities or malnutrition. Further research is needed to refine treatment strategies and improve long-term outcomes for these patients.

5. RECOMMENDATIONS FOR FUTURE RESEARCH

Future studies should adopt a multi-center approach to improve the generalizability of findings. In addition, long-term follow-up studies focusing on functional outcomes and quality of life post-decortication surgery would provide more comprehensive data. Future research should also explore the effect of preoperative rehabilitation, the management of comorbidities, and post-surgical adjuvant treatments on recovery in pediatric pleural empyema patients. Additionally, randomized controlled trials comparing decortication with other surgical or non-surgical interventions would help determine the most effective treatment modalities for pediatric patients.

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